

Minnesota's Regional Cardiac Program

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IN 1955 many out-of-state children were being brought to the University of Minnesota Hospitals for cardiac surgery because they lived in States which lacked the resources for the highly technical diagnostic processes and surgery required. The Children's Bureau, which had already established a pattern of regional heart programs, was asked to include the Minnesota facilities. Consequently, early in 1956, the Minnesota regional cardiac program was created for children with operable heart lesions who resided in States without appropriate facilities.

Surgical advances for open heart surgery in the early 1950's and their encouraging results had given new hope for many children with severe heart lesions. Parents were not only encouraged by physicians but they themselves were also eager to bring their handicapped children to Minnesota for cardiac surgery. The demands on one cardiac center became so great that children had to wait many months for open heart surgery.

Administration

The Minnesota crippled children services acts as a liaison between the referring State agency and the present Minnesota cardiac centers located at the University of Minnesota Hospitals in Minneapolis and at the Mayo Clinic in Rochester. The crippled children services pays for diagnostic workup and treatment at the cardiac center whether the child is an outpatient or hospitalized. Payment is made for the medical specialists and for hos-

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pital care including cost of special nurses and blood if the family cannot obtain donors. The standards for these centers are those recommended by the American Heart Association (1).

The crippled children's agency in the patient's home State may refer a patient to this regional cardiac program by sending medical and social information to the Minnesota crippled children services. The referring State agency is responsible for determining the financial eligibility; however, the cardiac center decides on acceptance of the patient from the medical point of view. The referring State agency states its choice among the centers, and the center gives priority for appointment according to the severity of the cardiac lesion. The cardiac center consults directly with the family concerning blood donors, the necessary consent for medical care and surgery, and unforeseen problems for either the parent or child that may arise during the child's stay in Minnesota. The cardiac center sends a detailed medical report to the referring physician when the patient is discharged and two copies of the report to Minnesota crippled children services, which forwards one copy to the referring State agency.

Findings

From the beginning of Minnesota's regional cardiac program in April 1956 to July 1, 1960, 695 different children were served at the cardiac centers. Of these, 396 children (57.0 percent) made one visit, 219 (31.5 percent) two visits, 68 (9.7 percent) three or four visits, and only 12 children (1.8 percent) made five or more visits.

Although the patients were referred from

38 States, 60 percent came from 3 States bordering Minnesota: North Dakota, South Dakota, and Wisconsin. Less than 10 children each were referred by 63 percent of the States (table 1).

White children (97.1 percent) predominated. Boys and girls were nearly equally distributed. The distribution by race and sex was essentially the same as for those children provided service in all the regional cardiac centers during 1952-56 (2).

The number of children served in each fiscal year has increased (table 2). Only seven children received care during the first fiscal year because the program did not begin until April.

The number of children receiving surgery during each fiscal year varied from 37.1 to 57.1 percent (table 2). During the entire period 57.7 percent of the 695 children had cardiac

surgery. Only four children had two operations under our auspices. However, it is not known how many children had cardiac surgery prior to their admittance to one of the cardiac centers. The percentage of children who received surgery at the Minnesota centers was larger than was reported for the regional cardiac centers during 1952-56. This high percentage undoubtedly reflects some of the advances made in cardiac surgery during the past few years.

The hospital mortality (table 2) for surgical and nonsurgical patients varied from 7.1 to 14.3 percent for the fiscal years. During the entire period 87 (12.5 percent) of the 695 children died while receiving care at a cardiac center. The mortality rate for all the regional centers during 1952-56 was 8.3 percent. Seventy-four (18.5 percent) of the 401 children having

Table 1. Distribution of children referred to Minnesota regional cardiac program, April 1956-July 1, 1960, by referring State

State	Number of children	State	Number of children	State	Number of children
North Dakota.....	203	Oregon.....	10	Connecticut.....	3
South Dakota.....	142	Kentucky.....	9	Idaho.....	3
Wisconsin.....	69	New York.....	7	Indiana.....	3
Florida.....	29	Arizona.....	6	Ohio.....	3
Hawaii.....	26	Nebraska.....	6	Colorado.....	2
California.....	23	Alabama.....	5	Mississippi.....	2
Montana.....	22	New Jersey.....	5	New Hampshire.....	2
Kansas.....	18	Oklahoma.....	5	New Mexico.....	2
Georgia.....	17	Virginia.....	5	Arkansas.....	1
Missouri.....	13	Washington.....	5	Massachusetts.....	1
Illinois.....	12	Wyoming.....	5	Pennsylvania.....	1
Iowa.....	11	North Carolina.....	4	South Carolina.....	1
Michigan.....	10	Tennessee.....	4		

Table 2. Distribution of children in each fiscal year by surgery, hospital mortality, age, and payments, Minnesota regional cardiac program, April 1956-July 1, 1960

Fiscal year	Children		Surgery patients		Hospital deaths		Age (years)					Payment ³
	Total	New	Number ¹	Per-cent ²	Number	Per-cent ²	Under 1	1-4	5-9	10-14	15-20	
1955-56.....	47	7	4	57.1	1	14.3	-----	4	2	1	-----	\$9,882.86
1956-57.....	178	176	66	37.1	19	10.7	21	76	46	25	10	83,082.90
1957-58.....	165	124	73	44.2	21	12.7	14	71	47	22	11	125,157.69
1958-59.....	212	148	89	42.0	15	7.1	20	81	60	35	16	154,707.20
1959-60.....	344	240	173	50.3	31	9.0	32	141	88	59	24	218,547.23

¹ 4 children had 2 operations.

² The percentages listed are relative to the total number of children.

³ Payments are exclusive of insurance benefit.

⁴ Program began in April 1956.

surgery died at or shortly after surgery. This high mortality undoubtedly reflects the serious and complex cardiac lesions referred to the Minnesota regional cardiac centers.

The average age of the children on their first admission to a cardiac center was 6.4 years. The largest number (12.2 percent) of children for any age group were seen in their first year of life. The second largest number (11.8 percent) of children were in their second year of life. The age distribution (table 2) was similar to those at the other regional centers (2).

The primary diagnosis (table 3) for the 695 children reflects the interest of the cardiac centers. When two or more diagnoses were given, only the primary diagnosis at surgery or catheterization was used. Interventricular septal defect, tetralogy of Fallot, and interauricular septal defect were the most common cardiac lesions. Twenty-four children (3.5 percent) had no heart disease, and 8 children (1.2 percent) had heart disease other than congenital heart disease or rheumatic fever.

More than three-fourths of the children had surgery at their first visit to a cardiac center. This high percentage reflects the accurate diagnosis and wise selection of the children who were sent to the centers. An equal number of children under 1 year, 1 year, and 2 years old had surgery. Forty-seven percent of the 232

children under 3 years and 44 percent of the 339 children under 5 years had surgery.

The hospital mortality for surgical and non-surgical patients showed considerable variation for the different diagnoses (table 3). The highest mortality was for those with transposition of the great vessels, tetralogy of Fallot, and pulmonary stenosis.

Among the 85 children under 1 year of age, 35 (41.2 percent) had surgery. Eleven of those infants had surgery for patent ductus or coarctation of the aorta, and 24 infants had surgery for interventricular or interauricular septal defects, or a complex cardiac malformation. The survival rate for the infants with patent ductus or coarctation of the aorta was 90.1 percent. Of those with open heart surgery, 68 percent survived. During this period there was an increase in the survival rate.

To learn what happened to these children after they returned home, we wrote to the referring State agency or family to obtain information about the child's health, if he had not been to one of these cardiac centers within the past year. Of 584 children dismissed from a cardiac center and known to have heart disease, current information has been obtained for 95.2 percent. It has been possible to follow those children who had surgery for 1.9 years. Seven children had surgery elsewhere and 19

Table 3. Primary diagnoses of cardiac lesions, mortality and surgery, Minnesota regional cardiac program, April 1956-July 1, 1960

Diagnosis	Children		Hospital deaths		Surgery patients			
	Number	Percent	Number	Percent	Number	Percent	Hospital deaths	
							Number	Percent
Interventricular septal defect.....	253	36.4	33	13.0	155	61.2	32	20.6
Tetralogy of Fallot.....	92	13.2	21	22.8	64	69.6	17	26.6
Interauricular septal defect.....	66	9.5	7	10.6	41	62.1	7	17.1
Patent ductus arteriosus.....	54	7.8	2	3.7	49	90.7	1	2.0
Pulmonary stenosis.....	48	6.9	7	14.6	24	50.0	6	25.0
Aortic stenosis.....	34	4.9	2	5.9	11	32.4	2	18.2
Coarctation of aorta.....	29	4.1	3	10.3	23	79.3	2	8.7
No heart disease.....	24	3.5	0	0	0	0	0	0
Other heart malformation.....	23	3.3	3	13.0	4	17.4	0	0
Atrioventricular communis.....	22	3.1	3	13.6	19	86.4	3	15.9
Other circulatory malformation.....	18	2.6	2	11.1	5	27.8	1	20.0
Transposition of great vessels.....	13	1.9	4	30.8	6	46.2	3	50.0
Other than congenital heart disease..	8	1.2	0	0	1	12.5	0	0
Mitral stenosis.....	7	1.0	0	0	3	42.8	0	0
Diagnosis deferred.....	4	.6	0	0	0	0	0	0

children had surgery at one of these cardiac centers after July 1, 1960. Fifty-three children died after leaving the cardiac center; the survival rate for the entire group during this period was 79.9 percent. The survival rate for those who did not have surgery was 81.1 percent and for those who had surgery 77.0 percent. The mortality continues to be highest for those children with transposition of great vessels and tetralogy of Fallot. Their cardiac condition was the cause of death for all but three of the children.

During this period the regional cardiac program spent \$591,377.88, exclusive of insurance benefits. Insurance payments were available for 26.5 percent of the children. During the last 2 fiscal years insurance payments were made for 41.6 percent of the children. Almost all of these payments were made for the child's hospital and medical care while he was hospitalized, and rarely was any insurance payment made for outpatient care.

The average cost of hospital and medical care, which included insurance payments if available, for a catheterization was \$375, for closed heart surgery \$900, and for open heart surgery \$1,850. The range of the cost for closed heart surgery was \$510 to \$1,818 and for open heart surgery \$650 to \$5,418. The wide variability in the cost of open heart surgery arose partially from the average increased length of hospitalization, which was 24 days instead of the 13 days needed for closed heart surgery, but mainly complications, such as heart block, prolonged hospitalization and the need for special nurses. This high variability has made it ex-

tremely difficult to predict the cost of medical care for children with cardiac lesions amenable to surgery.

Summary

From the beginning of Minnesota's regional cardiac program in April 1956 to July 1, 1960, 695 children received service at two cardiac centers. Although these children were referred from 38 States, 60 percent came from 3 States bordering Minnesota.

Eighty-seven children died in the hospital. Of 401 children having surgery, 74 died at or shortly after surgery. The mortality rate was highest for children with transposition of the great vessels, tetralogy of Fallot, and pulmonary stenosis.

Expenditures for open heart surgery varied from \$650 to \$5,418, with an average of \$1,850. The wide variation in cost was due to complications which prolonged hospitalization as well as the need for special nurses. Also, excluding complications, hospitalization was longer for open heart surgery than for closed heart surgery. The average cost for hospital and medical care for closed heart surgery was \$900.

REFERENCES

- (1) American Heart Association, Committee on Congenital Heart Defects: Standards for centers caring for patients with congenital cardiac defects. *Circulation* 21: 79-81, April 1960.
- (2) Chenoweth, A. D., and Saffian, S.: Children with congenital heart disease served in regional centers, 1952-56. *Pub. Health Rep.* 75: 377-386, May 1960.

Environmental Factors in Nursing Homes

A course on the environmental health factors in nursing homes will be given by the Training Branch of the Communicable Disease Center, Public Health Service, in Atlanta, Ga., May 7-11, 1962.

The Service's Division of Chronic Diseases, which requested the course, has developed teaching materials that will be available later to State health departments desiring to conduct their own courses.

Accident prevention, fire safety, housekeeping, heating, and ventilation will be emphasized, but traditional environmental health subjects, such as food sanitation, water supply, and sewage facilities, will not be neglected.